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THE HOST SPECIFICITY OF *NEOLASIOPTERA LATHAMI* GAGNÉ (DIPTERA: CECIDOMYIIDAE) WITH NOTES ON ITS BIOLOGY AND PHENOLOGY

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Abstract.—The gall forming cecidomyiid fly *Neolasioptera lathami* Gagné, collected on *Baccharis halimifolia* and *B. neglecta,* was studied to determine its host specificity and, thereby, its suitability as a biological control agent for *B. halimifolia* in Australia. Emerging flies were confined to small containers in which cut stems of a range of plant species were available for oviposition. No eggs were laid on a plant other than a *Baccharis* species. These results and the absence of any field host records to the contrary demonstrated that this fly was specific to *Baccharis.* Permission to release this fly in Australia was granted by the appropriate authorities.

The North American shrub *Baccharis halimifolia* L. (Asteraceae: Astereae) is a serious weed in southeastern Queensland and northeastern New South Wales, Australia. For over 25 years a concerted effort has been made to find suitable biological control agents. During that time extensive surveys of both North and South America were conducted to locate host specific insects suitable for release into Australia. The most successful introduction to date has been a cecidomyiid fly, *Rhopalomyia californica* Felt that galls the terminal stems of *B. pilularis* DC. in California (McFadyen, in press).

Five species (two found in the United States and three in Argentina) of the genus *Neolasioptera* (Diptera: Cecidomyidae) also form galls on *Baccharis* spp. (Gagné 1971). The North American species, both reported from *B. halimifolia,* are *N. lathami* Gagné, which forms a soft globular gall, and the much rarer *N. baccharicola* Gagné, which forms a hard cylindrical stem gall. There are a further 12 Nearctic species of *Neolasioptera* that have been reared from stems of Asteraceae (Gagné, 1971).

This paper reports studies that were conducted to determine the host specificity of *N. lathami* to obtain permission for the release of the organism in Australia.

Biology

N. lathami is a small, rather fragile looking fly with a greatly reduced gut and apparently non-functional mouthparts. In the laboratory the flies were never observed to ingest either food or water or to produce feces. Mating occurred soon after emergence of the flies. The females were readily distinguished by the reddish color of their abdomens that were distended by vermil-

lion colored eggs. Oviposition occurred soon after mating with each female producing 100–150 eggs. The adults were short lived with most surviving 3–5 days.

Eggs were laid mostly on the surface of stem terminals but some were laid in leaf axils some distance down the stems. Neonate larvae entered the stems by pushing between the unopened leaf bud scales. Mortality was high at this stage and only a few gained entry and became established.

Communal galls formed as a result of several larvae entering the one bud. Fully developed galls vary from 1 to 3 cm in diameter; the size of the gall depending on the number of larvae present and also the rate of plant growth. A large gall might have as many as 15 larvae each in an individual chamber.

Before pupating, the mature larva removed all but a layer of epidermal cells from the distal end of the chamber giving it a "windowed" appearance. The larva then pupated in the chamber. Before eclosion the pupa moved to the outer end of the chamber and pushed through the remaining epidermal cells with the aid of the antennal horns. When all but a few abdominal segments protruded from the chamber the pupal skin split irregularly and the fly emerged. The pupal case remained attached to the gall.

Host Range, Distribution and Phenology

Galls of this fly have been reported previously on *B. halimifolia* along the eastern seaboard of the United States from New York to Mississippi (Gagné, 1971). In the present study galls of this fly were also collected west of this distribution as far as Del Rio in western Texas. Furthermore, galls were often collected from *B. neglecta* Britton, a new host record for this insect.

The galls were most abundant in spring. In Texas, mature galls were found as early as the end of March. By end of spring, parasitism appeared to be the most important mortality factor. It was then quite common to fail to recover a single fly from a collection of galls. Only occasional galls were seen in Texas during the remainder of the year.

Table 1. Mean egg counts on bouquets of plants exposed to *N. lathami* emerged from galls collected from either *B. neglecta or B. halimifolia.*

Plant	Galls From	
	B. neglecta	*B. halimifolia*
Baccharis halimifolia L.	>65	>400
Baccharis neglecta Britt.	>150	>550
Solidago altissima L.	0	0
Chrysothamnus nauseosus (Pall.) Britt.	0	0
Aster novae-angliae L.	0	0
Helianthus annuus L.	0	0
Dahlia pinnata Cav.	0	0

In Texas, galls were never very abundant and only rarely were more than 10–20 galls found on the one plant. At these population levels the insect had little effect on the growth of mature plants. However, in Florida seedling plants only a few inches high were seen with as many as five large galls and these caused severe stunting.

Host Specificity Testing

Oviposition.—Because the adult fly is the only mobile stage the species could be considered monophagous if specificity of oviposition could be satisfactorily demonstrated. Two series of tests were therefore conducted to determine the specificity of oviposition.

A smaller test using plants closely related to *Baccharis* was conducted in Texas. In each of two 35 × 27 × 17 cm clear plastic cages two bouquets of foliage and growing tips of each of seven plants were randomly placed. Into one cage were placed galls collected from *B. halimifolia* near Conroe, Texas and into the other were placed galls collected from *B. neglecta* near Temple, Texas. After sufficient exposure to the emerging flies, the bouquets were examined

Table 2. List of plant species against which *N. lathami* was tested in order to obtain permission to release it in Australia.

APIACEAE: *Daucus carota* L.; *Pastinaca sativa* L.
ANACARDIACEAE: *Mangifera indica* L.
ASTERACEAE: *Baccharis halimifolia* L.; *Carthamus tinctorius* L.; *Chrysanthemum* sp.; *Dahlia* sp.; *Helianthus annuus* L.; *Lactuca sativa* L.
BRASSICACEAE: *Brassica oleraceae* (L.) Alef.; *Brassica rapa* L.
BROMELIACEAE: *Ananas comosus* (L.) Merr.
CARICACEAE: *Carica papaya* L.
CHENOPODIACEAE: *Beta vulgaris* L.
CONVOLVULACEAE: *Ipomoea batatas* (L.) Lam.
CUCURBITACEAE: *Cucumis melo* L.; *Cucumis sativus* L.; *Curcubita maxima* Duch.
FABIACEAE: *Arachis hypogaea* L.; *Centrosema pubescens* Benth.; *Desmodium canum* (Gmel.); *Glycine wightii* (R. Grah. ex Wight & Arn.) Verdc.; *Glycine max* L. Merr.; *Medicago sativa* L.; *Phaseolus atropurpureus* DC.; *Phaseolis vulgaris* L.; *Pisum sativum* L.; *Stizolobium* sp.; *Stylosanthes gracilis*; *Trifolium repens* L.; *Vigna catjang* V.
LINACEAE: *Linum usitatissimum* L.
MALVACEAE: *Gossypium hirsutum* L.
MIMOSACEAE: *Leucaena leucocephala* (Lam.) de Wit.
MUSACEAE: *Musa sapientum* M.
PASSIFLORACEAE: *Passiflora edulis* Sims
PINACEAE: *Pinus radiata* D. Don.; *Pinus taeda* L.
POACEAE: *Avena sativa* L.; *Digitaria decumbens* Stent.; *Pannicum maximum* Jacq.; *Paspalum dilatatum* Poir.; *Pennisetum clandestinum* Chiov.; *Saccharum officinarum* L.; *Sorghum vulgare* L.; *Triticum aestevum* L.; *Zea mays* L.
PROTEACEAE: *Macadamia integrifolia* Maid & Betche
ROSACEAE: *Fragaria vesca* L.; *Malus sylvestris* Mill.; *Prunus domestica* L.; *Prunus persica* (L.) Batch.; *Pyrus communis* L.; *Rosa* sp.
RUTACEAE: *Citrus limon* (L.) Burm. F.; *Citrus paradisi* Macfady.; *Citrus reticulata* Blanco; *Citrus sinsensis* (L.)
SAPINDACEAE: *Litchi chinensis* Sonn.
SOLANACEAE: *Capsicum annuum* L.; *Lycopersicum esculentum* Miller; *Nicotiana tabacum* L.; *Solanum tuberosum* L.
VITACEAE: *Vitis vinifera* L.
ZINGIBERACEAE: *Zingiber officinale* Roscoe.

under a binocular microscope and any eggs deposited were counted. The results (Table 1) indicated that both populations of flies oviposited on both species of *Baccharis* but not on any other plant.

A more comprehensive testing program, designed to satisfy the Australian Department of Health's requirements for introduction into Australia, was conducted using 65 species of plants (Table 2). This list of plants included the most important agricultural species. Bouquets of the growing tips of 8 plant species from the list, together with a bouquet of *B. halimifolia* were placed into glass and stainless steel aquaria (60 × 36 × 40 cm). Twenty-five pairs of flies from galls collected in Florida were placed in each cage. Each test was duplicated. Eggs were counted after a three day duration. Many eggs were deposited on all the *B. halimifolia* controls but none were found on any other plant.

Gall development tests.—A series of tests was carried out in an insectary to determine on which plants galls would develop. Each group of well-developed potted plants was infested with 25 pairs of flies collected in Florida. Each test was duplicated. After three days the plants were placed in a glasshouse. Hatching, movement of larvae and gall formation were observed and recorded. Eggs were found only on the *B. halimifolia* plants. After three to five days, larvae emerged and entered the young tips. There was no movement of these larvae onto other plants. Galls were formed in two weeks and the life cycle was completed in six to eight weeks.

Discussion

The experimental work supported the previous host records from the field by indicating that *N. lathami* is host specific to those species of *Baccharis* on which it is found in the field (i.e. *B. halimifolia* and *B. neglecta*). Permission was therefore sought and obtained to import and release this insect for the biological control of *B. halimifolia* in Australia.

Although this fly does not cause dramatic control in its native habitat, this does not preclude it from being successful in a new environment. The fly has a high reproduction rate and a short life cycle. The fact that

it is usually at low population densities is due primarily to the high rate of attack by parasites. Before being released in Australia parasites will be very carefully eliminated from the population in a quarantine facility. Without these parasites a much higher population of the fly may develop in Australia, perhaps to a level where significant effect on the population of the weed may occur.

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